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In re Application of:
Stefan Barkarö et al.

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Title: Echo Canceling Arrangement

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SUBMISSION OF PRIORITY DOCUMENT

Dear Sir:

We enclose herewith a certified copy of Swedish patent application SE 0103414-9 which is the priority document for the above-referenced patent application.

Respectfully submitted,
BAKER BOTTS L.L.P. (023640)

Date: June 30, 2004

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PRV

PATENT- OCH REGISTRERINGSVERKET

Patentavdelningen

Intyg Certificate

Härmed intygas att bifogade kopior överensstämmer med de handlingar som ursprungligen ingivits till Patent- och registreringsverket i nedannämnda ansökan.

This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

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För Patent- och registreringsverket
For the Patent- and Registration Office



Hjärdís Segerlund

Avgift
Fee *170:-*

ECHO CANCELLING ARRANGEMENT**TECHNICAL FIELD**

The invention relates generally to line driver/receiver circuits and more specifically to an
5 echo cancelling arrangement in such circuits.

BACKGROUND OF THE INVENTION

In many broadband applications such as Asymmetric Digital Subscriber Line (ADSL), a
receive signal is received in a line driver/receiver circuit at the same time as a transmit
10 signal is sent over one and the same transmission line.

The transmit signal that is much stronger than the receive signal that is damped by the
transmission line, will be coupled with its distortion into the receiver and degrade the
signal-to-noise ratio (SNR) of the receive signal.

15 Since the bitrate of the receive communication is decided in advance during a so-called
training sequence by the detected SNR for the receive signal, also the bitrate of the
receive signal will degrade.

20 To solve this problem, it is known to use echo cancellers.

Fig. 1 on the appended drawing is a schematic illustration of an embodiment of a known
line driver/receiver circuit with an echo cancellation bridge.

25 The line driver 1 is connected with its output terminals via equal drive impedances Z_T to
a load impedance Z_L that comprises a transformer connected to a transmission line that is
connected to a subscriber station with a line driver/receiver circuit for transmitting and
receiving signals to and from the transmission line.

30 The receiver 2 is connected with its input terminals to the load Z_L for simultaneously
receiving a receive signal from the transmission line.

To cancel the transmit signal and distortion on the input terminals of the receiver 2, the input terminals of the receiver 2 are connected to the load via equal resistors R1 and to respective output terminal of the line driver 1 via equal resistors R2.

5

In the embodiment in Fig. 1, the sum of the drive impedances $2Z_T$ shall have the same impedance value as the load impedance Z_L .

10

Since the output impedance of the line driver 1 is very low compared to the drive impedances Z_T , no receive signal at all will be present at the interface between the line driver 1 and the resistor bridge R1, R2. However, at the interface between the resistor bridge R1, R2 and the load Z_L both transmit and receive signals will be present.

15

It can be shown that by applying the resistor bridge R1, R2, the transmit signal can be totally cancelled at the input terminals of the receiver 2 while the receive signal is still present.

20

In line drivers with active termination impedance, the drive impedance Z_T in Fig. 1 would be set by a feedback loop inside the line driver 1. The advantage of such line drivers is that the output signal levels can be lowered for a given transmit power over the load Z_L . Hereby, it will be possible to reduce the supply voltage and, consequently, the power consumption.

25

However, also in such line drivers, there is a need of good echo cancellation of transmit signals at the receiver input.

SUMMARY OF THE INVENTION

The object of the invention is to bring about good echo cancellation in line drivers/receiver circuits with active termination impedance.

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This is attained by providing complex sense impedances to match the load impedance. The sense impedance value should be much smaller than the impedance value of the load impedance seen between the outputs of the line driver. Transconductance amplifiers are used for sensing the voltage across the sense impedances and supplying corresponding currents to respective input terminal of the line driver. To achieve echo cancellation a pure resistive bridge is applied across the sense impedances. The output of the bridge is connected to the receiver.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be described more in detail below with reference to the appended drawing on which Fig. 1, described above, illustrates a known line driver/receiver circuit with an echo cancellation bridge, and Fig. 2 illustrates a line driver/receiver circuit with active termination impedance with an echo cancellation arrangement according to the invention.

DESCRIPTION OF THE INVENTION

Fig. 2 illustrates a line driver/receiver circuit with active termination impedance with an echo cancellation arrangement according to the invention.

Components in Fig. 2 that are identical to components in Fig. 1 are provided with identical reference characters.

In accordance with the invention, a line driver 3 is connected with its output terminals via equal so-called sense impedances Z_S to a load Z_L that, in the same manner as in Fig. 1, comprises a transformer connected to a transmission line that is connected to a subscriber station with a line driver/receiver circuit for transmitting and receiving signals to and from the transmission line.

A receiver 2 is connected with its input terminals to the load Z_L for simultaneously receiving a receive signal from the transmission line.

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As in Fig. 1, the input terminals of the receiver 2 are connected to the load Z_L via equal resistors R_1 and to respective output terminal of the line driver 1 via equal resistors R_2 .

5 In accordance with the invention, the sense impedances Z_S are complex impedances to match the load impedance Z_L , and are of an impedance value that is much smaller than the impedance value of the load impedance Z_L .

10 In accordance with the invention, the voltage across the respective sense impedance Z_S is sensed by means of transconductance amplifiers 4, 5 that are connected with their input terminals across the respective sense impedance Z_S , and with their output terminal to respective input terminal of the line driver 3.

15 The transconductance amplifiers 4, 5 generate output currents corresponding to the sensed voltage. These output currents are supplied to the respective input terminal of the line driver 3.

20 The drive/termination impedance of the line driver equals $k \times Z_S$, where k is a function of the gains of the line driver 3 and the transconductance amplifiers 4, 5. The drive/termination impedance is correctly matched to the load when $k \times Z_S = Z_L$. Any combination of k and Z_S that fulfills this equation can be chosen.



CLAIM

- In a line driver/receiver circuit where the line driver is connected with its output terminals to a load (ZL) for supplying a transmit signal thereto and where the receiver is
- 5 connected with its input terminals to the load (ZL) for simultaneously receiving a receive signal therefrom, an arrangement for cancelling the transmit signal on the input terminals of the receiver, the output terminals of the line driver being connected to the load via equal first impedances, the input terminals of the receiver being connected to the load (ZL) via equal first resistors (R1) and to respective output terminal of the line driver via
- 10 equal second resistors (R2), characterized in
- that the first impedances (ZS) are complex impedances to match the load impedance (ZL) and are of an impedance value that is much smaller than the impedance value of the load impedance (ZL), and
 - that transconductance amplifiers (4, 5) are provided to sense the voltage across the first
- 15 impedances (ZS) and supply corresponding currents to respective input terminal of the line driver (3).

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ABSTRACT

In a line driver/receiver circuit where the line driver (3) is connected with its output terminals to a load (ZL) for supplying a transmit signal thereto and where the receiver (2) is connected with its input terminals to the load (ZL) for simultaneously receiving a receive signal therefrom, the transmit signal on the input terminals of the receiver (2) is cancelled by connecting the output terminals of the line driver (3) to the load (ZL) via equal complex sense impedances (ZS) of an impedance value that is much smaller than the impedance value of the load impedance (ZL) to match the load impedance (ZL), connecting the input terminals of the receiver (2) to the load (ZL) via equal first resistors (R1) and to respective output terminal of the line driver (3) via equal second resistors (R2), and providing transconductance amplifiers to sense the voltage across the sense impedances (ZS) and supply corresponding currents to respective input terminal of the line driver (3).

Fig. 2 to be published

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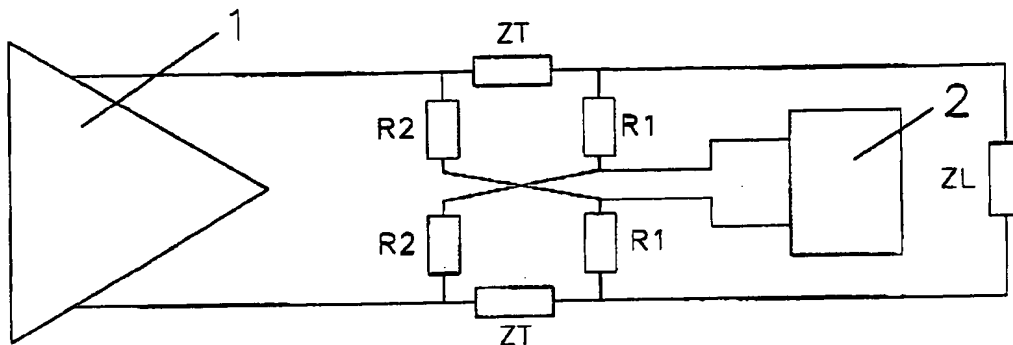


Fig.1

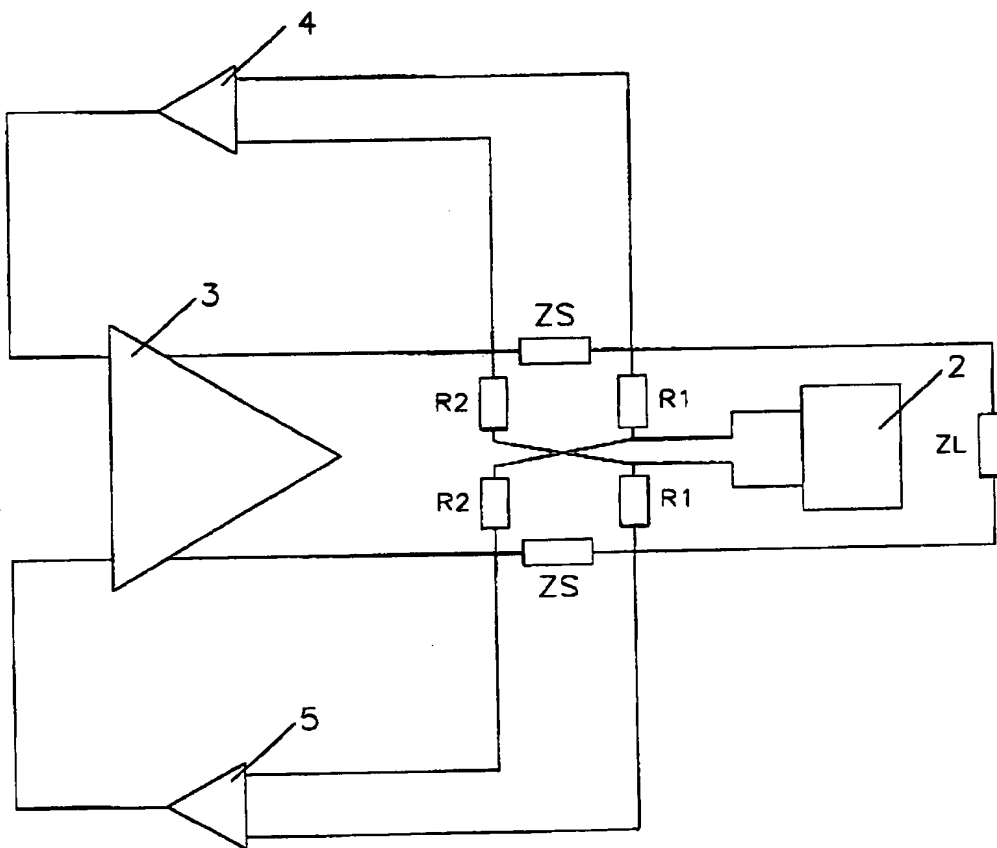


Fig. 2